

Holbrook Oil #1
NE/4-NE/4 Sec23-Twp15N-R18E 96
Navajo County, New Mexico

P-W

County Navajo
Area _____
Lease No. _____

Well
Name Holbrook Oil Company #1
Jerome Navajo Div Co below 2500
Location NE/4 Sec 23 Twp 15N Range 18E Footage _____
Elev 6023 OMI 201 Gr _____ KB Date 1924 Completed 1925 Total 3440-5505
Abandon _____ Depth 3023 Confirmed 1948
Approx. 3775
Contractor: _____ Cost \$ _____

Casing Size Depth Cement

8" 2380 _____
6 5/8 2674 _____

Drilled by Rotary _____
Cable Tool _____

Production Horizon _____

Initial Production D&A

REMARKS Table II
Darcy Haveri. G + O. Poss NE Az - State Land Dept, 1948 shows T.D. 3775
Poss in Devonian at T.D. Completed in 1925 Also OMI #201

Log in our files shows T.D. 3023' Nov. 1, 1924.

ABM. B. 130, p. 39 shows T.D. 3775.

Elec. _____ Sample Log _____
Logs (1) Sample Descrip. X
Applic _____ Plugging _____ Completion _____ Sample Set _____
to Plug _____ Record _____ Report _____ Cores _____

Water well - accepted by _____

Bond Co. _____
& No. _____

Bond Am't \$ _____ Cancelled _____ Date _____
Organization Report _____

Filing Receipt _____ Dated _____ Well Book _____ Plat Book _____

Loc. Plat _____ Dedication _____

PERMIT NUMBER none Date Issued _____

#9-6

Log of HOLBROOK WELL, in NE Sec. 23-15N-18E, Navajo County, Navajo Field, Arizona.

0- 2380 8" casing (No Driller's log available)
 2500 Drilled by old Holbrook company. Jerome Navajo Drg. Co.
 2610 started at 2500. Small water under casing some place.
 Water sand 5'. Good oil showing and gas. Caving.

8' (2672 Set 6-5/8" casing. Hard brown lime 8'. Sept. 4, 1924.
 (2674 Gone through lime and then 2' brown shale
 (2680

14' (2683 Into brown hard lime
 (2685 Into brown hard lime
 (2694 Through the hard lime

10' (2695 In brown shale. Strong gas smell.
 (2700 In brown shale. Strong gas smell.
 (2705 In brown shale. Strong gas smell.

3' (2706 Dark brown lime, hard.
 (2708 Dark brown lime, hard.

26' (2709 Brown shale
 (2714 Brown shale
 (2720 Brown shale
 (2725 Brown shale
 (2730 Brown shale; getting a little harder - Sept. 14, 1924.
 (2735 Brown shale
 (2736 Blue & brown shale; little lime in it, pretty hard. Good gas
 (2740 Blue & brown shale; 300' water left in hole. smell.
 19' (2750 Blue and brown shale.
 (2755 Blue and brown shale; 200' water left in hole. Sept. 16, 1924.

10' (2760 Dark brown shale. Gas smell good.
 (2765 Dark brown shale. Gas smell good.

13' (2774 Dark brown shale, with little blue shale.
 (2778 Blue and brown shale.

12' (2785 Chocolate shale.
 (2790 Chocolate shale.

(2795 Chocolate and blue shale.
 (2800 Same
 (2805 Same
 (2809 Same
 (2809 Chocolate and blue shale - small water sand bet. 2 shales.
 (2815 Chocolate and blue shale - strong gas; water petered out.
 (2819 Chocolate and blue shale/

no permit

2

80'	(2824	Chocolate and blue shale.
	(2830	Same
	(2835	Same
	(2840	Same
	(2845	Same
	(2850	Same
	(2855	Same
	(2860	Same
	(2865	Same
	(2868	Same
	(2869	Into a water sandstone carrying lots of gas; no cave.
3'	(2871	Going out of the water sand into shale.
	(2875	Into brown lime
8'	(2878	Going out brown lime into shale
	(2885	Brown-blue, turning gray, containing (elastic bitumen).
10'	(2888	minerals are thought to be petroleum robbed of its volatile matter and are chiefly paraffin with some naptha & benzine.
	(2890	Got water sand.
3'	(2893	Out of water sand.
	(2895	Into shale and lime
8'	(2900	Into shale and lime
	(2902	Water-sand about 2'
	(2905	Brown lime and little shale.
13'	(2908	Brown lime and little shale.
	(2915	End of lime.
	(2920	Blue and brown shale; lots of bitumen; more oil showing.
	(2925	Blue and brown shale; lots of bitumen.
2'	(2927	In a hard, white lime; looks like salt and pepper.
	(2930	In blue and brown shale.
5'	(2932	In blue and brown shale.
	(2937	In brown lime.
	(2940	Blue and brown shale.
	(2945	Blue and brown shale.
20'	(2950	Blue and brown shale.
	(2955	Blue and brown shale.
	(2957	Blue and brown shale; change to hard.
	(2965	Blue and brown shale, and 2 small lime layers.
18'	(2967	Blue and brown shale. Best bitumen showing; rainbow colors.
	(2975	Blue and brown shale. Best bitumen showing; rainbow colors.

The Permit

4 :

7'	(2976	In a hard, brown lime; less bitumen
	(2982	In a hard, brown lime; in the limes.
3'	(2985	Shale; brown and blue. Good gas smell here.
2'	(2987	Small lime streak, 2'.
	(2992	Shale, brown and blue. Bitumen very strong; all colors
8'	(2995	Shale, brown and blue. rainbow.
2'	(2997	Lime streak, 2'.
7'	(3004	Shale, brown and blue; lots of bitumen; rainbow colors.
6'	(3010	Shale, brown predominates; red; sticky; not much bitumen.
	3012	Shale, blue predominates; lots of bitumen.
	3015	Blue and brown shale; caving; pretty bad going; had to stop and pull casing, and straight-ream.
	3020	Ft. difference in measurement.
	3023	Bottomed on hard lime; kind of white specks with the brown.

November 1, 1924.

No permit

Holbrook Oil #1
Log of Holbrook Well, in NE Sec. 23, T. 15 N., R. 18 E., Navajo County,
Navajo Field, Arizona

TD 3023

0	2380 2500 2610	8" Casing (no driller's log available) Drilled by old Holbrook Company, Jerome Navajo Drlg. Co. started at 2500. Small water under casing someplace. Water sand 5'. Good oil showing and gas. Caving.
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3'	(2706 (2708	Dark brown lime, hard Dark brown lime, hard
26'	(2709 (2714 (2720 (2725 (2730 (2735 (2736	Brown shale Brown shale Brown shale Brown shale Brown shale; getting a little harder - Sept. 14, 1924 Brown shale Blue & brown shale; little lime in it, pretty hard. Good gas smell.
19'	(2740 (2750 (2755	Blue & brown shale; 300' water left in hole. Blue and brown shale. Blue and brown shale; 200' water left in hole, 9/16/24
10'	(2760 (2765	Dark brown shale. Gas smell good. Dark brown shale. Gas smell good.
13'	(2774 (2778	Dark brown shale, with little blue shale. Blue and brown shale
12'	(2785 (2790	Chocolate shale Chocolate shale
	(2795 (2800 (2805 (2809 (2809 (2815 (2819	Chocolate and blue shale Same Same Same Chocolate and blue shale-small water sand bet. 2 shales. Chocolate and blue shale-strong gas; water petered out. Chocolate and blue shale
80'	(2824 (2830 (2835 (2840 (2845 (2850 (2855 (2860 (2865 (2868	Chocolate and blue shale Same Same Same Same Same Same Same Same Same
3'	(2869 (2871	Into a water sandstone carrying lots of gas; no cave Going out of the water sand into shale.
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HOLBROOK WELL

NAVAJO COUNTY

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November 1, 1924

Formation Tops from State Land Department Files -

Helbrook well - deepened from 2500' by Jerome
Navajo Drilling Co.

0 - ?	Cocconino
? - 2500	Supai
2500 - 3023	Supai
TD? 3023	

6000

the permit

Holbrook Oil Company. The well sunk by this company on the southern flank of the Holbrook monocline, about ten miles northwest of the Adamana hole, in Sec. 23, Township 15 N., Range 18 E, 21 miles southwest of Holbrook, was drilled to a depth of 2,400 feet in 1922.

The Jerome-Navajo Drilling Company. (Organized in 1924 to continue the Holbrook well). This company drilled to a depth of 3,775 feet in 1925. Traces of gas and oil were reported at that depth.

Hopi Oil Company. The well of this company, about half way between the Holbrook and Adamana holes, was carried down 2,500 feet. A few showings of gas were reported. This hole is in Sec. 21, Township 15 N., Range 19 E., about twenty miles southwest of Holbrook. The lower Paleozoic beds were not tested.

Great Basin Oil Company. This company, promoted by E. S. Taylor, sank its well in 1925 and 1926, considerably north of the Holbrook monocline, five miles southwest of Holbrook on a doubtful structure. The hole was carried down to a depth of 4,675 feet, and was drilled to within a few hundred feet of the base of the Paleozoic section. Traces of oil were reported at about 1,700 feet and again from 4,245 to the bottom of the hole.

Conclusion. The Holbrook monoclinial fold is a major structural feature of the region which extends in a southeasterly direction from between Clear and Chevelon creeks, south of the railroad to about eleven miles east of Snowflake, a distance of fifty miles. This structure has been tested only in one limited part, covering a distance on the strike of about 12 miles, and there by only two holes. At the points tested, definite traces of gas and oil were found at various horizons. The results achieved, although disappointing, are, notwithstanding, inconclusive.

ZUNI AREA

In this area, about twenty miles northeast of Holbrook, there exists a very gentle synclinal trough with minor crinklins, a structure not favorable for oil accumulation.

Oil Prospecting: One hole was put down by the *Zuni Oil Company* in Sec. 6, Township 19 N., Range 24 E., 22 miles northeast of Holbrook. The well was drilled over 1,000 feet deep and it was reported that a trace of oil was found at 950 feet. The hole started in Triassic and penetrated only the top Paleozoic sandstones.

LUPTON STRUCTURE

This structure, on the southern end of the Defiance Uplift, is a

(9-6) The Holbrook boring (No. 1) about three miles west of the Hopi hole is reported to have entered red shale at 511 feet, which continued to 935 feet, interrupted by limestone from 680 to 692 feet and by gypsum at intervals from 692 to 865 feet and some salt from 855 to 935 feet. Apparently there are local salt basins in Permian and Pennsylvanian strata in this region.

The westernmost bore hole, which is at the Black Canyon claim in Section 20, T. 16, R. 17, was sunk 476 feet with diamond drill. The cores were nearly all light colored sandstone (Coconino). Some layers were found to contain considerable calcium carbonate and a few thin layers of shale were penetrated. The mesa at this place is capped by the thin Kaibab limestone, the upper part very sandy. A boring for water at Winslow had reached a depth of 965 feet late in 1924 all in Coconino sandstone below 100 feet. The overlying Kaibab was thin.

The thinning of the Kaibab limestone in the plateau south of Holbrook is an interesting feature which has been described in considerable detail on a previous page. It results in the disappearance of the formation at Holbrook, although its thin edge is well characterized a short distance south of that place and near Winslow and Snowflake. It is absent in the basin northeast of Holbrook and in the Defiance uplift where the Moenkopi formation, and to the northward the Shinarump conglomerate, lies on the Coconino sandstone.

As shown in Plate 52, the dome of the Holbrook region trends northwest and finally flattens out in the monocline southeast of Winslow. It is broad and flat to the southeast along the Little Colorado River, which cuts a canyon across it, mostly with walls of Coconino sandstone, from near Snowflake to Holbrook. Woodruff Butte consists of Moenkopi, Chinle, and Shinarump beds in a shallow basin, capped by basalt (See Pl. 60a.) Possibly the vent from which this latter rock came is in the butte. Just east of Taylor there is a small local dome in which the Coconino sandstone is revealed overlain by yellow sandy Kaibab limestone only a few feet thick.

The Sinks are on the south slope of the large dome, about 10 miles northwest of Snowflake. There are 30 or 40 of them, ranging from a few yards to 100 yards in diameter, in an area about a mile in length, and all near or on the steep dip to the south. Most of them expose sandstone of Coconino aspect (see Pl. 60b), overlain by Kaibab limestone, here 20 or 30 feet thick. Undoubtedly this sandstone is underlain by a limestone member which has been removed in places by solution in underground waters passing into the valley of Dry Lake to the southward.

This latter valley is a syncline filled with Moenkopi formation, as shown in the cross section (Fig. 28), which extends nearly to Cheylon Canyon. In the center of the basin, southwest of the Sinks, are two buttes capped by Shinarump conglomerate.

The Moenkopi extends far up the slopes south of Dry Lake Valley, and on an irregular surface of this formation and in places overlapping on to the Kaibab limestone, is the cap of Upper Cretaceous strata which

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RECORD OF ADAMANA BORE HOLE, SEC. 4, T. 14, R. 20,
SOUTHWEST OF HOLBROOK, ARIZONA

Feet	Material	Formation
0- 60	Red shale	Moenkopi
60- 80	Limestone, yellow, very sandy	Kaibab
80- 394	Sandstone, yellow	Coconino
394- 439	Shale, white	
439- 549	Sandstone, mostly buff, some reddish	
549- 680	Sandstone, white	
680- 692	"Limestone", hard	Supai
692- 855	Red shale, some gypsum and salt	
855-1040	Shale, brown	
1040-1050	Lime, blue	
1050-1090	Shale, brown, and salt	
1090-1745	Shale, blue and brown, salt	Redwall
1745-1950	Limestone, blue	
1950-2040	Sandstone and salt	
2040-2150	Shale, brown	
2150-2345	Limestone, some shale	

This record was to the end of January, 1921. A year later the depth was 350 feet greater, and soft, brown beds were being penetrated. In February, 1923, the depth was about 3,000 feet and the material was black shale. The Supai formation appears to be about 1,065 feet thick in this hole, but there is some uncertainty as to its lower limit.

RECORD OF HOPI BORING, IN SEC. 21, T. 15 N., R. 19 E.,
SOUTHWEST OF HOLBROOK, ARIZONA

Feet	Material	Formation
0- 465	Sandstone, hard, cross-bedded, gray to buff	Coconino
465- 625	Sandstone, red	Supai
629- 697	Limestone, sandy, red	
697- 710	Sandstone, gray	
710-1075	Shale, etc., red	
1075-1200	Sandy shale, black	
1200-1725	Sandstone, red, with salt beds, (limestone, 1550-1590 feet)	Redwall
1725-1788	Limestone, very hard, black on blue	
1788-1875	Sandstone	
1875-2175	Red sandstone with salt in upper half	
2175-2355	Limestone, red, sandy, hard	
2355-2400	Sandstone, buff	
2400-2420	Sandy limestone and sandstone, red	

Another record gives red sand and shale 2196 to 2235 feet, lime and shale, 2235 to 2505 feet, and white "lime," 2505 to 2520 feet. Possibly the base of the Supai was at 1725 feet, but red material occurs in underlying strata.

Early in 1925 the Taylor-Fuller boring penetrated arkosic sandstone 3685-3870 feet, limestone 3870-3994 and red and brown hard sandstone 3994-4112 feet, possibly strata of the Apache group which outcrop on Canyon Creek 60 miles southwest.

- 20 -

Adams Oil Company. Well No. 1. Located in SW $\frac{1}{4}$ SE $\frac{1}{4}$ Section 4, T. 14 N., R. 20 E. Drilled to depth of 4,100 feet and operations suspended. A good oil showing was reported. A log was not available. The company proposes to resume operations and test for production.

Area visited April 21, 1933.

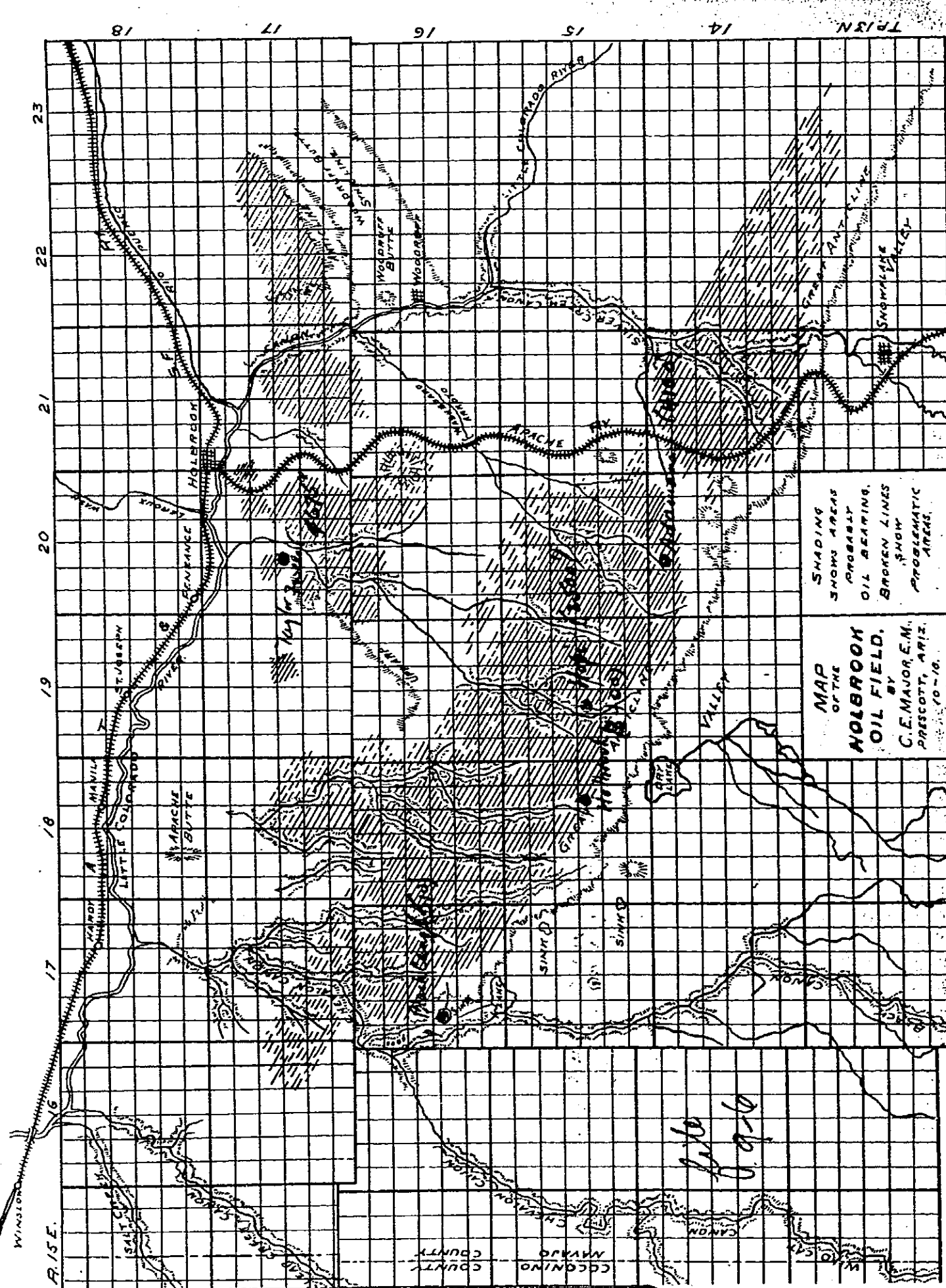
9-6 { Bellrock East. Well is located in the NE $\frac{1}{4}$ Section 25, T. 15 N., R. 18 E., S. & S. R. E. Drilled to depth of approximately 3,400 feet. No log or information available at this time.

Sunshine Oil Company. Well No. 1. NW $\frac{1}{4}$ SW $\frac{1}{4}$ Section 13 T. 20 N., R. 18 E., S. & S. R. E. Drilling commenced in Fall of 1932. Drilled to depth of approximately 350 feet and suspended operations. The company is reorganizing and will probably resume operations in the near future. Well visited April 24, 1933.

Logs which are lacking in this report will probably be obtainable later. The photographs attached were furnished by Mr. Bob Thomas, of Globe, Arizona, and pertain to wells in this report.

Reported by

R. H. Canfield,
Assistant Petroleum Engineer.



MAP
OF THE
HOLBROOK
OIL FIELD.
BY
C.E. MAJOR, E.M.,
PRESCOTT, ARIZ.
1910-16.

SHADING
SHOWS AREAS
PROBABLY
OIL BEARING.
BROKEN LINES
SHOW
PROBLEMATIC
AREAS.

1910-16

Petroleum

Geology and Oil Prospects

of

Holbrook District

Arizona

by

Harry R. Johnson

*Union Oil Building
Los Angeles*

August 18, 1919

file 96

CONTENTS

Introduction.....	Page 1
Location and Geography.....	" 1
Topography.....	" 1
Maps and Photographs.....	" 1
Development and Operation to Date.....	" 3
Results Obtained by Drilling.....	" 3
Geology and Structure.....	" 4
Surface Indications of Oil.....	" 7
Conclusions Concerning Possibilities.....	" 8

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Introduction

In view of activity toward oil development near Holbrook, Arizona, which, in addition to arousing intense local interest, is now commanding the attention of outside operators, a review of the conditions found there will be presented, including present development, status of lands, and the indications and possibilities regarding oil.

Location and Topography

The town of Holbrook, about 900 population, is situated on the Santa Fe Railroad, 60 miles from the eastern border of the State. Two banks, several wholesale and retail merchandise establishments, two newspapers and half a dozen hotels make it headquarters of the ranching and Indian reservation interests, and lately, for oil development work in that section. It is on the Ocean-to-Ocean Highway, and dirt roads into the surrounding country are fairly well kept up. Winslow, Arizona, 33 miles west of Holbrook (population 2000) may also be considered within the oil development area.

The Little Colorado River flows intermittently thru both Holbrook and Winslow, the wells 300 feet deep and reservoirs formed by damming creeks form the water supplies of the towns. A sparse growth of scrub timber, found on the hills south of Holbrook, is a source of fuel for drilling, and coal is brought in from New Mexico. The elevation of Holbrook is 5,080 ft; that of Winslow is 4,850 ft.

Topography

The Holbrook district is situated on the plateau province of Arizona, at the south border of the Navajo County which extends with little variation in topography north 175 miles into Utah. The surface is cut by occasional deep canons, due to the swift torrential streams. As a rule, the region is a prairie country, with scattered buttes, the remnants of lava flows or erosional features. To some extent the topography conforms with the bedding, comprising a gently rolling surface that follows the barely perceptible bend of the hard sandstone strata beneath. The plateau country, from the Utah border to 90 miles south of Holbrook, maintains an elevation between 4800 and 6000 feet throughout.

Maps and Photography

The accompanying composite map will serve to indicate the geographic, topographic and geologic conditions of this district. The stratigraphy is based on Herbert E. Gregory's U.S.G.S. Professional Paper, 93, long accepted as a standard on the geology of the Navajo County. The structural geology, as mapped, is the result of the writer's investigations made in a general way only, and not detailed. The accompanying photographs show the general appearance of the country, and the position from which each was taken is indicated on the map.

Development and Operations to Date

The Aztec Land and Cattle Company have been in possession for a number of years, of nearly a million acres of land in this district, formerly owned by the Santa Fe Railroad. A portion of this land has recently been leased by the Hopi Oil Company of Holbrook, and in October of 1918, a well was started on their property in Sec. 21, T. 15 N., R. 19 E., at the end of July 1919, a depth of 2050 ft. had been reached with no showing except a slight color at about 425 ft. (This showing appears in the oil wells drilled so far and in water wells, and will be commented on later.) The Wind River Oil Co., of Wyoming is drilling this well for the Hopi Oil Company on a participating interest basis.

9-6 The Holbrook Oil Company, with close to 60,000 acres of patented and leased land, is drilling a well on Sec. 23, T. 15 N., R. 18 E., now 100 ft. and waiting for tools.

9-2 The Adamana Oil & Land Company, with 40,000 acres, has reached a depth of 1060 ft. on Sec. 4, T. 14 N., R. 20 E., drilling.

9-9 The Black Canyon Oil Company (McCloskey interests of Holbrook) with 50,000 acres has drilled to 500 ft. with a core drill on Sec. 20, T. 16 N., R. 17 E., severateen miles southerly from Winslow.

The Apache Oil & Development Company has a location in Sec. 7, T. 16 N., R. 21 E.; the Holbrook Oil Co. a location in Sec. 22, T. 17 N., R. 21 E.; the Lone Star Oil Co. a location in Sec. 6, T. 19 N., R. 23 E.; the Suni Oil Co. a location in Sec. 6, T. 19 N., R. 24 E.

Other Arizona companies organized to secure leases include the Winslow Oil Co., Chevron Oil Co., Home Oil Co., Klatawa Oil Co., Holbrook Investment Co., Winslow Mutual Oil Association, and Shamrock Oil & Development Co., all of whom contemplate putting down rigs eventually and are at present offering leases or shares on the market in any size blocks. The land is thoroughly taken up to the extent of some 1100 square miles.

Geologist representing the Carter Oil Co., Commonwealth Oil Co., Allen Oil Co. (of Oklahoma) Union Oil Co., of California, Standard Oil Co. of California and Sinclair Oil Co., have visited the district in the past, it is reported.

Results Obtained by Drilling

The progress of the Hopi Oil Co., well in Sec. 21-15-19 is being watched with interest by all parties concerned in the Holbrook field. The depth of the oil bearing horizon (if one should exist) is purely speculative, inasmuch as there is no criterion in the way of drilled wells to guide the prospectors. At a depth of 2050 ft. the Hopi drill has passed the horizon that carried oil in the San Juan Oil field, 160 miles to the north, where wells of

small production (5 to 15 bbls. per day) were secured at depths ranging from 300 to 750 ft. The Hopi well is drilling with standard tools in an open hole, encountering alternate sandstone and lime, with very little shale. At 1950 ft. very little water had been encountered, tho at 2025 ft. the drill penetrated a "saturated water sand." This is considered significant from the standpoint that it indicates the possible presence of sufficient underground water to assist in the accumulation of oil, a point which will be touched upon later in this report.

The other drilling wells in the locality have not reached sufficient depth to add to the knowledge of underground conditions. However, the Adamana in sec. 4-14-20 encountered a 50 ft. bed of impure salt at a depth of 650 ft., which was not noted in the Hopi well. Similar salt deposits were noted in water wells near Winslow and elsewhere.

With the test wells now drilling, a rea fifty miles long and some fifteen miles wide will be proven up, provided the wells are carried to sufficient depth. The broad form of folding found in this territory does not sharply segregate the district into likely and unlikely territory as in California or Wyoming fields, though the anticlines and synclines are sufficiently well developed as to make each a separate drilling possibility.

Geology and Structure

The Navajo Country of Arizona comprises a well recognized geographical and geological unit. It includes a gently rolling plateau area that extends roughly from the Utah border south thru Arizona 190 miles or 50 miles south of the Santa Fe Railroad and Holbrook; and from the Colorado and Little Colorado Rivers on the west to the Continental Divide (approximating Gallup, New Mexico) on the east. The general elevation of the surface of this plateau is between 4800 and 6000 ft.

Throughout this plateau the sedimentary strata (of Mesozoic and Paleozoic age) extend without perceptible break and with little warping except at the boundaries of the region. The slight warping on a broad scale, has placed the bed in the form of a geo-syncline extending southerly from the San Juan River (and oil fields) in Utah to Holbrook, though making a long general slope upward to and south of Holbrook. Along a line situated fifteen miles south of Holbrook this upward slope terminates and the beds bend over in an anticlinal fold that is barely perceptible, and assume a dip toward the south. The gentle folding is on such a large scale that many smaller anticlinal and synclinal folds are encountered as one traverses the district. Thus the "great anticline" or "Holbrook structure," as the major anticlinal (or doming) fold has come to be known, is the location selected for prospecting by the Holbrook interests. The minor folds take the form of partly-closing domes on the flanks of the major structure, or anticlines and synclines whose trend has apparently little conformance with the trend of the major anticlinal axis. The location of many of the minor folds, both anticlinal and synclinal, have been selected by the various operators as suitable

locations for drilling, which accounts for the wide dispersion of test wells in the district.

The San Juan oil field, with its known oil measures, has been used by geologists as a criterion at Holbrook, as far as possible, though, as mentioned previously, the measures containing oil at San Juan have been pierced by the drill at Holbrook, and have proved unproductive. The geologic section at Holbrook may be given as follows:

Era	Period	Series	Group	Formation	Thickness (Estimated)	Description
Mesozoic	Triassic			Chinle	1000 Plus	Gray, purplish shale.
				Shinarump	5-20	Heavy conglomerate
				De Chelly	0-20	Red sandstone
Paleozoic	Carboniferous	Permian		Hoenkopie	100-200	Red shale and sandstone
				Kaibab	0-60	Limestone
		Pennsylvanian	Aubrey			
				Coconino	300	Gray & white cross-bedded sandstone
				Supai	1500	Sandstones & limestones (oil bearing at San Juan)
Proterozoic	Pre-Cambrian	Mississippian		Redwall	500 (?)	Limestone
		Cambrian	Tonto		900 plus (?)	Shales and sandstones
				Unkarachuar	5000 plus (?)	Shales, sandstones, quartzite, limestone, granites, gneiss, schists.

The surface rock in the vicinity of Holbrook is the Moenkopie. Toward Winslow the Moenkopie is entirely eroded away, exposing the Kaibab Limestone, which is there only 8 ft. in thickness. The Coconino sandstone is exposed in the walls of Cheylon and Clear Creek Canons, southeast of Winslow. There the walls stand 100 ft. above the waters which have been dammed up to form reservoirs.

Thus the wells drilled thus far penetrate a lower portion of the Moenkopie; may or may not encounter the Kaibab limestone, according to their location (as the Kaibab does not underlie all this region;) and pass into the Supai Lower Pennsylvanian, the thickness of which is unknown here, but judging from distant outcrops, will probably be upwards of 1500 ft. This formation is oil bearing in the San Juan oil field (known there as the Goodridge sands of the Aubrey group.) The lower portion of the Supai is the objective of the drillers at Holbrook. The well of the Hopi Company as has been mentioned previously, has passed the upper members of the Supai and at 2050 ft. (August 1, 1919) should have reached the lowermost members, and has not yet encountered the oil. The well will be carried down into the Redwall lime if necessary, it is understood.

Beneath the Redwall limestone there is encountered in other parts of Arizona (Grand Canon section) a tremendous thickness of Cambrian and Pre-Cambrian sedimentaries that lie on the primitive granites and schists, the thickness, or even presence of which beneath the Holbrook area is unknown, and their possibilities as a source of petroleum is highly improbable.

As regards lava flows in this vicinity, remnants of basaltic flow rock are still to be found at no great distance, notably at Woodruff Butte, 10 miles southeast of Holbrook, where a resistant basaltic cap rests on the chert shales. Other basaltic remnants occur in large masses 25 miles north of Holbrook. Twin Buttes, 18 miles north of Holbrook, are of intrusive origin.

The plateau region in general has been the scene of intrusive action thru-out Triassic, Tertiary and even recent ages, the region 75 miles southeast of Holbrook (near Springerville) and 40 miles west of Winslow (San Francisco Mountain volcanic field) being notable examples of fresh volcanic activity, with unusually perfect cinder cones and lava flows. The particular region about Holbrook and Winslow, however, has not been subjected to volcanic action (though the general detrimental effect of neighboring intrusive activity on the accumulation of petroleum should not be overlooked.)

Faulting does not occur to any perceptible extent in the Holbrook area. The maximum dips encountered are $3\frac{10}{2}$ on the flanks of the smaller folds; the general dip of the beds toward the north on the north portion of the major anticline is $10\frac{1}{2}$, and the same toward the south.

Emphasis must be placed here upon the importance of under-

ground water as a factor influencing the accumulation of petroleum. A sufficient supply of underground waters, constituting a hydrostatic head, will tend to accumulate the oil in porous beds under an impervious shale or limestone cap in the top or apex of the anticlines and domes, due to the higher specific gravity of the water. Lack of water will allow the oil to settle in the synclines. In most oil fields the oil is found in the anticlines, where it is impounded by waters bearing it up from beneath. At the San Juan Oil Field, however, the oil is recovered from the synclines due to the absence of a hydrostatic head of water. In this case, the deep-cut canyons of the San Juan River and its tributaries have apparently drained the oil bearing strata of water, leaving the oil to settle in a general way in the synclines.

At Holbrook the feature of deep-cut canyons is not encountered; but it is possible in this region, where there is no higher land within forty miles, and where the stratification (level, resistant, compact beds) is conducive to quick run-off of surface waters, and where a general condition of aridity exists, that there may be the lack of underground waters necessary to the antilinal accumulation of oil.

On this hypothesis the location of the Adamana Oil Co. well, sec. 4-14-20, has been made on a syncline. In this connection also the logging of a "saturated water sand" in the Hopi Co. Well, Sec. 21-15-19, at 2025 ft. is significant, as mentioned previously, in that it gives an indication as to what may be expected of water conditions, and is considered in a favorable light by those who have selected antilinal locations for their prospect rigs. The relative value of antilinal locations for the accumulation of oil could only be determined by the drill, should oil be discovered in this section. The antilinal position would be preferred by the writer if guided by choice of location alone.

Surface Indications of Oil

As pointed out previously, the San Juan oil field, 160 miles north of Holbrook, is the most closely related point of oil production; and the oil measures there do extend south to Holbrook and are within reach of the drill there but have so far proven barren. Drilling commenced at San Juan in 1910, the wells being small producers of high grade oil.

The Seven Lakes oil field, 60 miles north of Gallup, New Mexico, 125 miles northeast of Holbrook, supports a number of 5 to 20 barrel wells. The oil is high grade, with reported high gasoline and lubricating stock contents, and the field, like the San Juan field, too far from transportation, is at present being exploited for further development. The oil horizon at Seven Lakes is evidently the Dakota sandstone, a Cretaceous member and much higher stratigraphically than the Holbrook area.

An oil seep is reliably reported to the writer to be found in Canyon de Chelly, 95 miles northeast of Holbrook (half way to San Juan) and another in Cibola Canon, 106 miles south of Holbrook.

The writer personally visited an oil seep, or group of seeps on Clear Creek, 7 miles southeast of Winslow. The seeps occur at the edge of the water in a reservoir formed by damming the steep walled gorge of Clear Creek, and can be reached only by boat (or, as in the writer's case by swimming.) A thin stream of brown oil exudes with water from crevices in the Coconino sandstone and spreads upon the surface of the reservoir. It is believed that this oil occurs at the base of the Coconino sandstone and is floated out by the waters of the reservoir, penetrating the surrounding strata. Considerable gas, with unmistakable petrolific odor, bubbles thru the water. There is no evidence of faulting that would allow this oil to reach the surface here from great depths.

A similar seep is reported in the gorge of Cheylon Fork, also dammed up, 13 miles southeast of Winslow and 21 miles west of Holbrook.

In connection with these seeps on Clear Creek and Cheylon Fork are indications of oil in the form of colors and globules, with some gas, creditably reported and known for some years, to be found in various water wells drilled to depths of 300 to 500 ft. near Holbrook. Further, as mentioned previously in this report, the Hopi well reported a showing of colors and gas at 425 ft, which corresponds with the horizon of the Coconino sandstone. Hence the Coconino sandstone seems to be a member that contains oil in very small quantities, though has evidently been explored thoroughly without having proved productive.

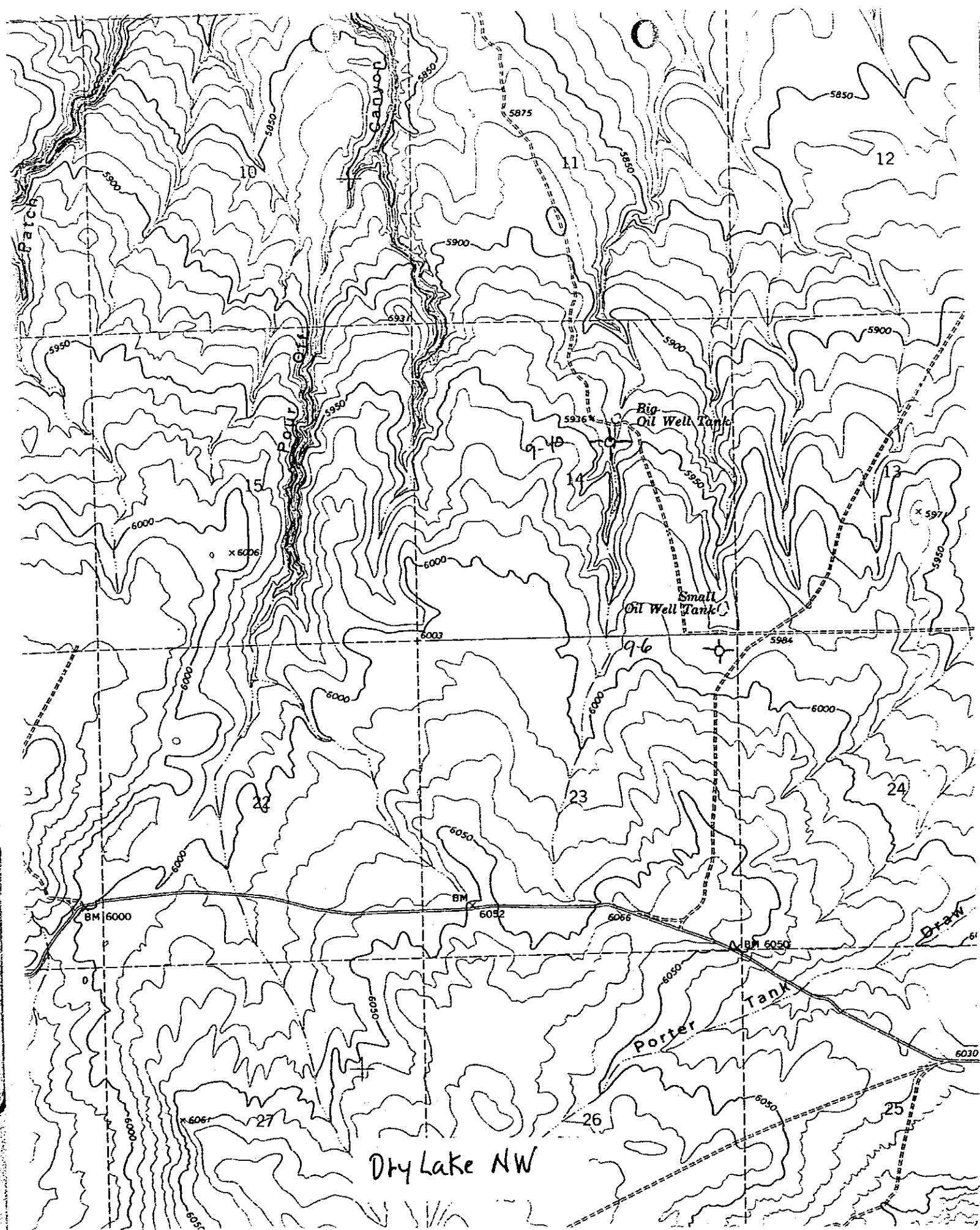
Conclusions Concerning Possibilities

The foregoing more or less detailed description of the geological and structural features of the Holbrook district will serve to indicate that if oil were present in the deep-lying sediments of the Navajo Country, the Holbrook major anticline, as well as a number of the minor folds accompanying it, would offer some promise of accumulation. However, the fact that the sand measures above the Cambrian have been prospected without results, especially the Pennsylvanian series (Coconino sandstone) that showed some surface indications of oil at shallow depth; the nature of the sedimentary rocks, lacking in carbonaceous or diatomaceous shales throughout; the questionable presence of underground hydrostatic pressure; the adverse conditions created by (geologically) recent igneous activity in the general region; the knowledge that such oil is produced in New Mexico and Utah is derived from horizons above those in which Holbrook interest are now drilling, and that the Mississippian beds where exposed in this region are known to have shown no evidences of petroleum; together with the fact that all the wells in the New Mexico and Utah fields have scarcely produced oil in commercial quantities, makes the Holbrook area, in the writer's opinion, an unpromising one, where the possibility of securing petroleum is extremely unlikely.

The section of country fifty miles east of Holbrook presents a better appearance for the accumulation of petroleum than that at

Holbrook. Anticlinal structures of more pronounced folding are evident, and the area is more worthy of prospecting. However conditions that govern the accumulation of oil at Holbrook will apply also to this region. The land in the vicinity of Houck on the Santa Fe Railroad, has not been located for oil possibilities and should any oil be encountered in the drilling activities near Holbrook, this territory should command the attention of operators.

Los Angeles, California.
August 18, 1919.

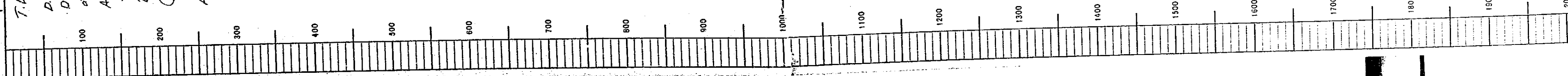


NE 23	NAVAJO Co. 1
DET.	COMPANY
15411E	H. Brook Co.
NO. 1	
19	
19	
COMPLETED	
REMARKS:	
ELEVATION	
6020 @ M1	

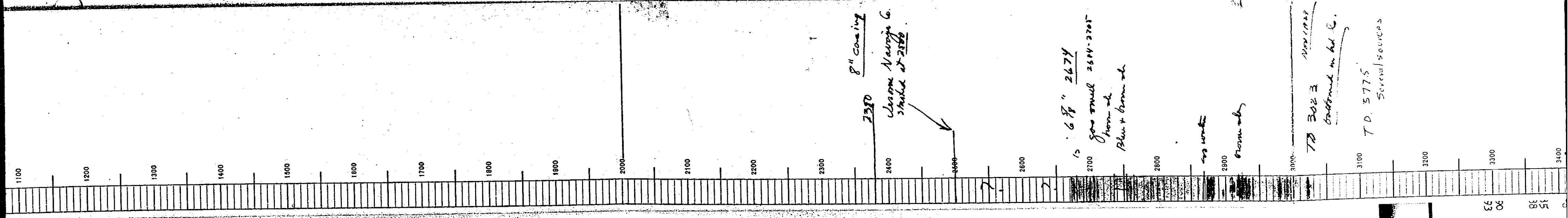
T.D. 3775'

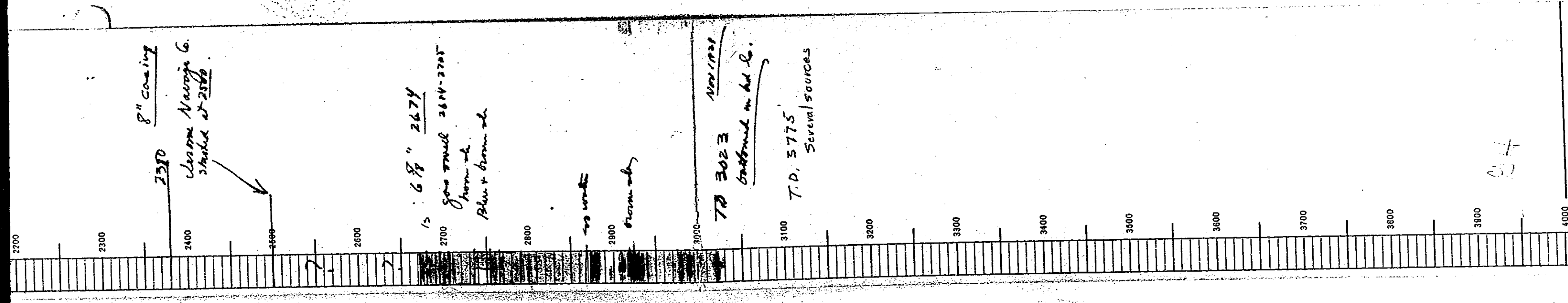
D.D. by Jerome - Navajo
D.H.G. Co. below 2500' to
at least 3023'

Apparently D.D. in 1925
to 3775', based on
Dowsey Hyer data.
(St. L. Dept. Report, 1942)
Table II
Also, Az. E. M. Bull 130,
p. 59 shows T.D. 3775'.



(2885
(2890
(2893





0' (2885)
 10' (2888)
 31 (2890)
 (2893)

Log of Holbrook Well, in NE Sec. 23, T. 15 N., R. 18 E., Navajo County,
Navajo Field, Arizona

No number

9-6

0	2380	8" Casing (no driller's log available)
	2500	Drilled by old Holbrook Company, Jerome Navajo Drilg. Co. started at 2500. Small water under casing someplace.
	2610	Water sand 5'. Good oil showing and gas. Caving.
8'	(2672 (2674 (2680	Set 6-5/8" Casing. Hard brown lime 8'. Sept. 4, 1924 Gone through lime and 2' brown shale
14'	(2683 (2685 (2694	Into brown hard lime Into brown hard lime Through the hard lime
10'	(2695 (2700 (2705	In brown shale. Strong gas smell In brown shale. Strong gas smell In brown shale. Strong gas smell
3'	(2706 (2708	Dark brown lime, hard Dark brown lime, hard
26'	(2709 (2714 (2720 (2725 (2730 (2735 (2736	Brown shale Brown shale Brown shale Brown shale Brown shale; getting a little harder - Sept. 14, 1924 Brown shale Blue & brown shale; little lime in it, pretty hard. Good gas smell.
19'	(2740 (2750 (2755	Blue & brown shale; 300' water left in hole. Blue and brown shale. Blue and brown shale; 200' water left in hole, 9/16/24
10'	(2760 (2765	Dark brown shale. Gas smell good. Dark brown shale. Gas smell good.
13'	(2774 (2778	Dark brown shale, with little blue shale. Blue and brown shale
12'	(2785 (2790	Chocolate shale Chocolate shale
	(2795 (2800 (2805 (2809 (2809 (2815 (2819	Chocolate and blue shale Same Same Same Chocolate and blue shale-small water sand bet. 2 shales. Chocolate and blue shale-strong gas; water petered out. Chocolate and blue shale
80'	(2824 (2830 (2835 (2840 (2845 (2850 (2855 (2860 (2865 (2868	Chocolate and blue shale Same Same Same Same Same Same Same Same Same
3'	(2869 (2871	Into a water sandstone carrying lots of gas; no cave Going out of the water sand into shale.
8'	(2875 (2878	Into brown lime Going out brown lime into shale
10'	(2885 (2888	Brown-blue, turning gray, containing (elastic bitumen) minerals are thought to be petroleum robbed of its volatile matter and are chiefly paraffin with some naptha & benzine.
3'	(2890 (2893	Got water sand Out of water sand

HOLBROOK WELL

NAVAJO COUNTY

8'	(2895 (2900	Into shale and lime Into shale, and lime
2'	(2902	Water-sand about 2'
13'	(2905 (2908 (2915	Brown lime and little shale Brown lime and little shale End of lime
10'	(2920 (2925	Blue and brown shale; lots of bitumen; more oil showing Blue and brown shale; lots of bitumen
2'	(2927	In a hard, white lime; looks like salt and pepper
5'	(2930 (2932	In blue and brown shale In blue and brown shale
5'	(2937	In brown lime
20'	(2940 (2945 (2950 (2955 (2957	Blue and brown shale Blue and brown shale Blue and brown shale Blue and brown shale Blue and brown shale; change to hard
	(2965	Blue and brown shale, and 2 small lime layers
18'	(2967 (2975	Blue and brown shale, Best bitumen showing; rainbow colors Blue and brown shale, best bitumen showing; rainbow colors
	(2976	In a hard, brown lime; less bitumen
7'	(2982	In a hard, brown lime, in the limes.
3'	(2985	Shale; brown and blue. Good gas smell here
2'	(2987	Small lime streak, 2'.
8'	(2992 (2995	Shale, brown and blue. Bitumen very strong; all colors rainbow Shale, brown and blue
2'	(2997	Lime streak, 2'
7'	(3004	Shale, brown and blue; lots of bitumen; rainbow colors.
6'	(3010 3012	Shale, brown predominates; red; sticky; not much bitumen. Shale, blue predominates; lots of bitumen.
	3015	Blue and brown shale; caving; pretty bad going; had to stop and pull casing and straight-ream
	3020 3023	Ft. difference in measurement. Bottomed on hard lime; kind of white specks with the brown

November 1, 1924

Holbrook Well #6

Depth - 129'
Bore - 16"
Completed in May, 1927
Casing - 16" perforated from 20' to 137'
Standing water level - 12.5' from surface
Pumping test by R. C. Kline May, 1927 produced
450 GPM
(Steel pump was drawing from the old dug well
at the same time and did not lower the water)

Log

0'	- 32'	Depth of old dug well
32'	- 50'	Yellow clay
50'	- 67'	Sandy clay
67'	- 80'	Sand and fine clay
80'	- 90'	Sand and gravel
90'	- 100'	Sand and gravel (water)
100'	- 137'	Gravel
137'	- 139'	Sandstone

See back of Well #4 for Analysis

Analyses of Wells #4 & #6

Grains per US Gal.

	#4	#6
Date	4-1-27	-----
Lab. No.	25975	26200
Cal. Sulphate	5.5	5.2
Mag. Sulphate	11.9	11.4
Cal. Carbonate	10.0	12.8
Mag.		
Iron, Aluminum & Silica		
Total Inconstants in Solution	27.4	29.5
Sodium Chloride	4819	42.8
Total Solids in Solution	76.3	72.3
Alkalinity	11.8	11.3
Suspended Matter		4.0